

We claim:

1. An object proximity sensor system for use in a motor vehicle having an occupant area defining an air bag deployment zone, and an air bag module, said object proximity sensor system comprising:

a light transmitter capable of emitting light beams that illuminate a predefined area and are capable of reflecting off an object positioned in the predefined area;

a light receiver capable of detecting the reflected light beams, said light receiver comprising an image sensor capable of acquiring an image of the object in the illuminated predefined area and capable of distinguishing a plurality of imaged spots in the image; and

a microcontroller coupled to said light receiver and operable to determine diameters of the imaged spots and to use the determined diameters to calculate the object's distance from said light transmitter.

2. The object proximity sensor system of claim 1 further comprising an image processor coupled to said image sensor for processing the image, said image processor operable with said microcontroller to determine the diameters of the imaged spots.

3. The object proximity sensor system of claim 2 wherein said object proximity sensor further comprises memory coupled to said microcontroller, said memory storing a look-up table containing imaged spot diameter data and object distance data.

4. The object proximity sensor system of claim 3 wherein said microcontroller determines the object's distance from said look-up table based upon the diameters of the imaged spots.

5. The object proximity sensor system of claim 4 wherein said microcontroller determines whether the object is within the airbag deployment zone based on the object's distance from said light transmitter.

6. The object proximity sensor system of claim 1 wherein said light transmitter includes a plurality of light emitters.

7. The object proximity sensor system of claim 6 wherein said plurality of light emitters include infrared light sources.

8. The object proximity sensor of claim 2 wherein said image processor is operable to remove noise from and perform feature extraction on said image.

9. In a motor vehicle having an occupant area defining an air bag deployment zone, and an air bag module, a method of establishing the distance between a light transmitter and a target positioned in the occupant area, said method comprising the steps of:

emitting a plurality of light beams, said light beams illuminating the occupant area and capable of reflecting off the target;

acquiring an image of the target in the occupant area, said image including a plurality of imaged spots produced by said reflected light beams, each of said imaged spots having a diameter;

determining the diameters of each said imaged spots; and

determining the distance of the target from the light transmitter based upon the diameters of said plurality of imaged spots.

10. The method of claim 9 wherein said step of determining the diameters of each said imaged spot includes a step of removing noise from said image.

11. The method of claim 9 wherein said step of determining the diameters of each said imaged spot includes a step of performing feature extraction on said image.

12. The method of claim 9 wherein said step of determining the distance includes a step of storing a look-up table containing imaged spot diameter data and object distance data.

13. The method of claim 12 wherein said step of determining the distance includes a step of selecting the distance from said look-up table based on the diameters of said imaged spots.

14. The method of claim 9 further comprising a step of determining whether said target is positioned within the air bag deployment zone based on the target's distance from the light transmitter.

15. The method of claim 14 further comprising a step of one of enabling the air bag module if the target is determined to be positioned within the air bag deployment zone and disabling the air bag module if the target is determined not to be in the air bag deployment zone.

16. An object proximity sensor for use in a motor vehicle having an occupant area defining an air bag deployment zone, and an air bag module, the object proximity sensor for use in determining the distance between a light transmitter and a target positioned in the occupant area, the object proximity sensor comprising:

light detecting means for detecting a plurality of light beams emitted by the light transmitter and reflected off the target, said light detecting means and the light transmitter adapted to be positioned proximate to the air bag module;

image capture means for capturing an image of the target in the occupant area, said image containing a plurality of imaged spots produced by said reflected light beams; and

means for determining diameters of each of said imaged spots and using the diameters to determine the target's distance from the light transmitter.

17. The object proximity sensor of claim 16 wherein said light detecting means includes a photodiode.

18. The object proximity sensor of claim 16 wherein said image capture means includes a charge-coupled device.

19. The object proximity sensor of claim 16 wherein said image capture means includes a complementary metal oxide semiconductor.

20. The object proximity sensor of claim 16 wherein said means for determining includes a microprocessor.

21. The object proximity sensor of claim 20 wherein said means for determining also includes an image processor coupled to said image capture means, said image processor operable to remove noise from and perform feature extraction on said image.

22. The object proximity sensor of claim 16 further comprising storage means coupled to said means for determining, said storage means storing a look-up table containing imaged spot diameter data and target distance data.

23. The object proximity sensor of claim 22 wherein said determining means selects the target's distance from said look-up table based upon the diameters of said imaged spots.

24. An object proximity sensor system for use in a motor vehicle having an occupant area defining an air bag deployment zone, the sensor system for determining the distance from an object, said sensor system comprising:

a plurality of light sources for generating a plurality of light beams that illuminate the object positioned in the occupant area;

imaging optics for imaging the plurality of light beams on a photosensitive device, said imaged light beams forming reflected imaged spots on said photosensitive device, said imaged spots each having a diameter;

an image processor in electrical communication with said imaging optics; and

a microcontroller coupled to said imaging optics and said image processor, said microcontroller and said image processor together operable to determine the diameter of said reflected imaged spots, and said microcontroller operable to use the diameters to determine the object's distance.

25. The object proximity sensor of claim 24 wherein said photosensitive device includes a photodiode.

26. The object proximity sensor of claim 25 further comprising memory coupled to said microcontroller, said memory including a look-up table containing imaged spot diameter data and object distance data.

27. The object proximity sensor of claim 26 wherein said microcontroller selects the object's distance from the look-up table based on the diameters of said spots.

28. The object proximity sensor of claim 24 wherein said light sources are arranged in a collimated array.

29. The method of claim 9 further comprising a step of determining whether said target is positioned within the air bag deployment zone based on whether a predetermined number of imaged spots is within a predetermined range.